

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 22 August 96	3. REPORT TYPE AND DATES COVERED Final Report 11/94-5/96	
4. TITLE AND SUBTITLE Nondestructive Real-Time Sensing of Stress Defects, and Flaws in Composite Materials			5. FUNDING NUMBERS DAAH04-95-1-0003	
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9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Office 4300 South Miami Boulevard P.O. Box 12211 Research Triangle Park, NC 27709-2211			10. SPONSORING / MONITORING AGENCY REPORT NUMBER ARO 33744.1-PH-41P	
11. SUPPLEMENTARY NOTES				
a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. ABSTRACT (Maximum 200 words) We have developed the use of a confocal microscope to characterize a new real-time holographic technique which is capable of quantitative measurement of residual stress. In particular, the confocal microscope is used to study and evaluate the visual quality of the surface of a test structure to determine defects and flaws in surface of the structure under stress. <div style="text-align: right;">DTIC QUALITY INSPECTED 3</div>				
14. SUBJECT TERMS Confocal microscope; residual stress			15. NUMBER OF PAGES 3	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED	

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FINAL REPORT FOR DAAH04-9501-0003

NONDESTRUCTIVE REAL-TIME SENSING OF STRESS DEFECTS, AND FLAWS IN COMPOSITE MATERIALS

The objective of our work is to develop a real time holographic technique to provide a quantitative measure of the stress and for the detection and location of defects in materials. The holographic device is small and portable and consequently can be used for in-situ measurements.

A great deal of research has been carried out on non-destructive testing using holography techniques. However, at the present time there is no device which can provide in-situ quantitative measurements of the detection and location of stress and defects in materials. All previous devices can only provide a qualitative measure of the displacement or vibration of a material. That is, by loading a material and carrying out measurements on a vibration isolation table only qualitative measurements of stress, strain, defects, have been reported using real-time holograph. Previous work therefore suffers from two important restrictions.

- (i) *the measurements must be carried out on a vibration isolation table*
- (ii) *the measurement only yields qualitative information on the magnitude of internal stress, strain, or defects and does not provide any information on the location of defects*

Our program is focused to address these two limitations. The concept we have in mind is to develop an instrument which is portable and can be used at manufacturing sites

and in-the-field in order to monitor the quality of materials. One can envision, for example, a diagnostic instrument which can report on the quality of a laser weld or laser drill in terms of a quantitative value for the developed stress or for the corresponding strength of the bond. One can just as easily envision the same diagnostic instrument available to report the presence of exclusions, defects, or flaws in composite materials.

In order to test the capability of our instrument it is important to first evaluate the material by other techniques. the most common evaluation is the use of a microscope. For this reason we requested and purchased a confocal microscope. The microscope gives us the capability to evaluate the surface of any material and to evaluate the bulk of transparent materials. The visual inspection of the material then makes possible a correlation between its appearance and our holographic measurements.

The confocal microscope was purchased under the program using 120 K DOD support and 30 K of University "matching" support. The research on the development of the holographic instrument is making great progress and the correlation with the microscope inspection data shows a high correlation between the techniques.